Space Weather Technical Forecast

Issued on Friday, 01 September 2023 at 01:16 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight chance of G1/Minor Storm intervals day 1 (01 Sep) from CH40 HSS, and later day 2 or early day 3 (02-03 Sep) due to CME arrival. Chance of Isolated M-flares (R1 Blackout) .

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with only minor C-class flares, mainly from AR3413 in the northwest. There are currently six sunspot regions on the visible disc. AR3413 remains the largest region and the most likely source of flare activity with ongoing development of peripheral spots, and a moderate complexity. AR3417 in the southeast, while smaller has a slightly more unusual structure with two main negative leaders, but only small trailer spots, while AR3415 in the southwest persists as a simple and slowly weakening bipolar spot. The other three regions are simple unipolar spots.

A filament lift-off was observed northwest of centre-disc at around 30/2100 UTC, along with a long period low C-class flare. An associated EUV wave was also evident in dimming imagery. This was a slightly unusual event as despite being from a source located to the northwest, the subsequent CME was to the south and slightly to the east, perhaps due to the proximity of CH40 to the northwest of the eruption. This CME has been analysed and is likely to arrive at Earth late on day 2 or early day 3 (02-03 Sep), but with low confidence.

At the same time, a further CME to the northeast was visible in coronagraph imagery, however this has been assessed as far-sided. A further CME was also observed from the long period C2.5 flare of AR3413 at 31/0613 UTC, to the northwest. This is still under assessment, but is not expected to be Earth-directed.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as observed by ACE/DSCOVR at L1, were typical of a slow wind regime throughout much of the period, before a potential earlier arrival of a HSS from CH40/+ at 31/1640UTC. Speeds were between 280-350km/s, before increasing to slightly elevated levels, peaking near 430km/s at 31/2026UTC. Density was mostly below average to average. The interplanetary magnetic field, Bt, was initially weak and below 7nT before rising to be moderate, peaking at +12nT from 31/1650UTC, with the earlier arrival of HSS from CH40/+. The north-south component, Bz, varied between +10nT and -6nT. Phi angle was predominantly negative (towards the Sun), before switching to become predominantly positive (away from the Sun) from 31/1640 UTC, which is indicative of the arrival of HSS from CH40/+. Geomagnetic activity was mostly Quiet (Kp1-2), with an isolated Unsettled (Kp 3) interval observed at 31/0900-1200 UTC.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux remained at background levels. GOES16 high energy (greater than 2MeV) electron flux was at background. The associated 24-hour fluence was well below the Active threshold, with 1.46e6 integrated pfu observed at 01/0000 UTC.

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Met Office Space Weather Technical Forecast

Four-Day Space Weather Forecast Summary

Solar Activity: Activity is expected to be Low with a chance of rising to Moderate due to any M-flares, most likely from AR3413 in the northwest.

Solar Wind / Geomagnetic Activity: CME from the filament eruption 30/2100 UTC, is currently anticipated to arrive late day 2 or early day 3 (02-03 Sep), before waning on day 4 (04 Sep). Solar winds are currently slightly elevated, which looks likely to be an earlier arrival of the fast wind from CH40/+ located in the northwest quadrant and is being largely obscured from view. This HSS is then likely to ease for a time, before the CME arrival. Quiet geomagnetic activity at first is forecast to become Unsettled to Active with a slight chance of G1/Minor Storms due to the early arrival of HSS from CH40/+ during day 1 (01 Sep). Any CME arrival later day 2 or early day 3 (02-03 Sep) will then bring a chance of G1/Minor Storms, with a slight chance G2 Moderate Storms, before easing later day 4 (04 Sep).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux is expected to remain at background levels. High energy (greater than 2 MeV) electron flux is expected to persist mainly at background, but perhaps rising briefly in response to any HSS enhancement day 2 (02 Sep), before likely dropping out again with any CME arrival. The associated 24 hour fluence is expected to remain below the Active level (1e8 integrated pfu).

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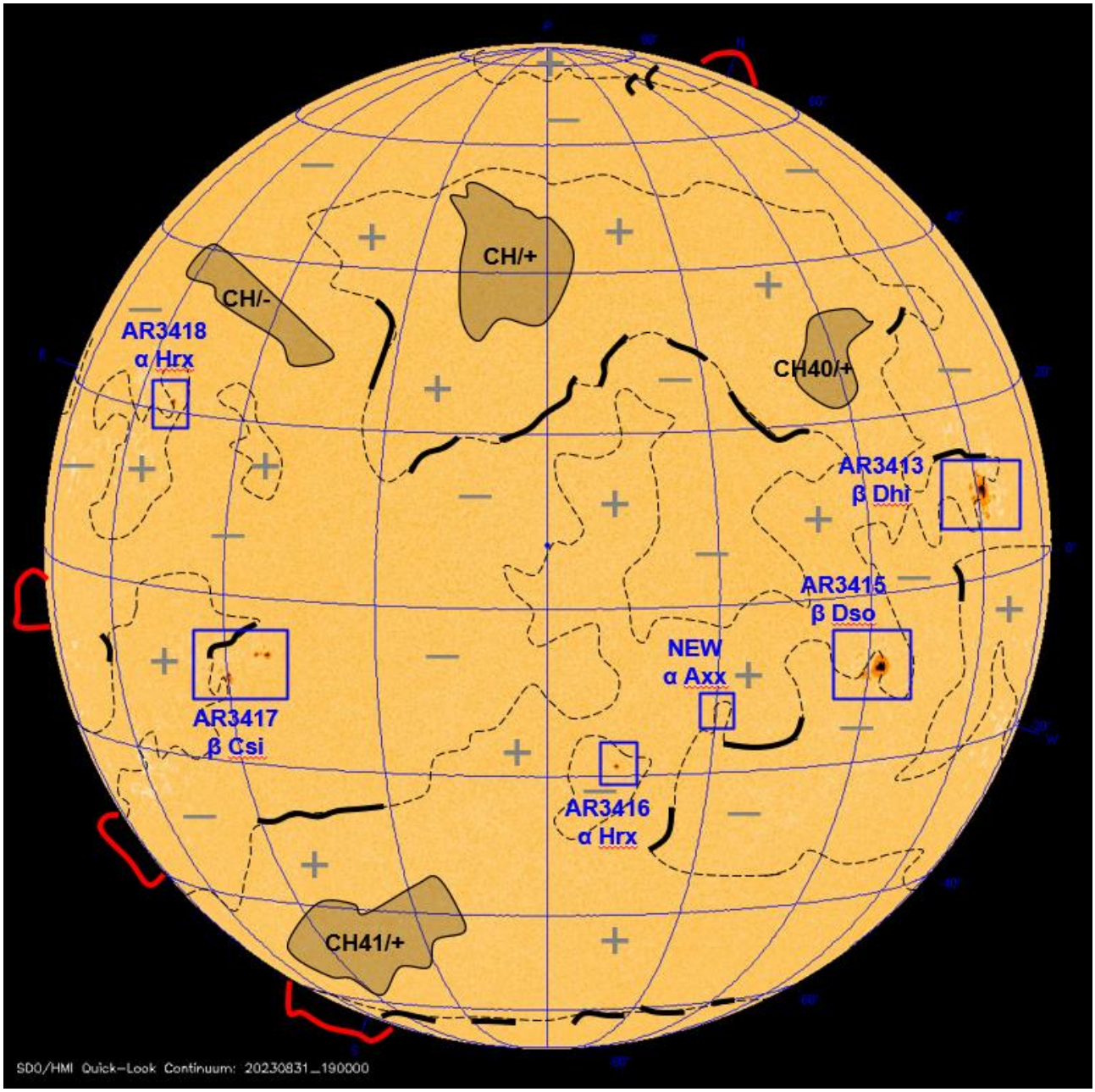
Figure 1. Solar Analysis Valid 31/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME from the filament eruption around 30/2100 UTC, has undergone analysis and is anticipated to arrive late on 02 Sep or early 03 Sep.

The fast wind from CH40/+ looks to have arrived earlier than anticipated, with solar winds currently slightly elevated, near 430km/s, probably rising to near 500km/s during day 1 (01 Sep). Geomagnetic activity will be initially Quiet, increasing to Unsettled or Active intervals, with a slight chance of G1/Minor Storm interval during day 1 (01 Sep).

The CME arrival is then anticipated either later on 02 Sep or early 03 Sep (day 2-3) bringing a further chance of Active to G1 Minor Storms, and a slight chance of G2 Moderate Storms. before effects gradually wane on day 4 (04 Sep).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	30	30	20
Strong	G3	No	1	5	5	2
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
31/0305	Partial	Filament	NW, but directed SE	610km/s	02/2200 +/- 9 hrs	Low confidence, due to unusual CME signature.

Figure 2: MOSWOC Enlil (top) and ensemble (below) shows expected arrival of the CME either late on 02 Sept or early 03 Sept

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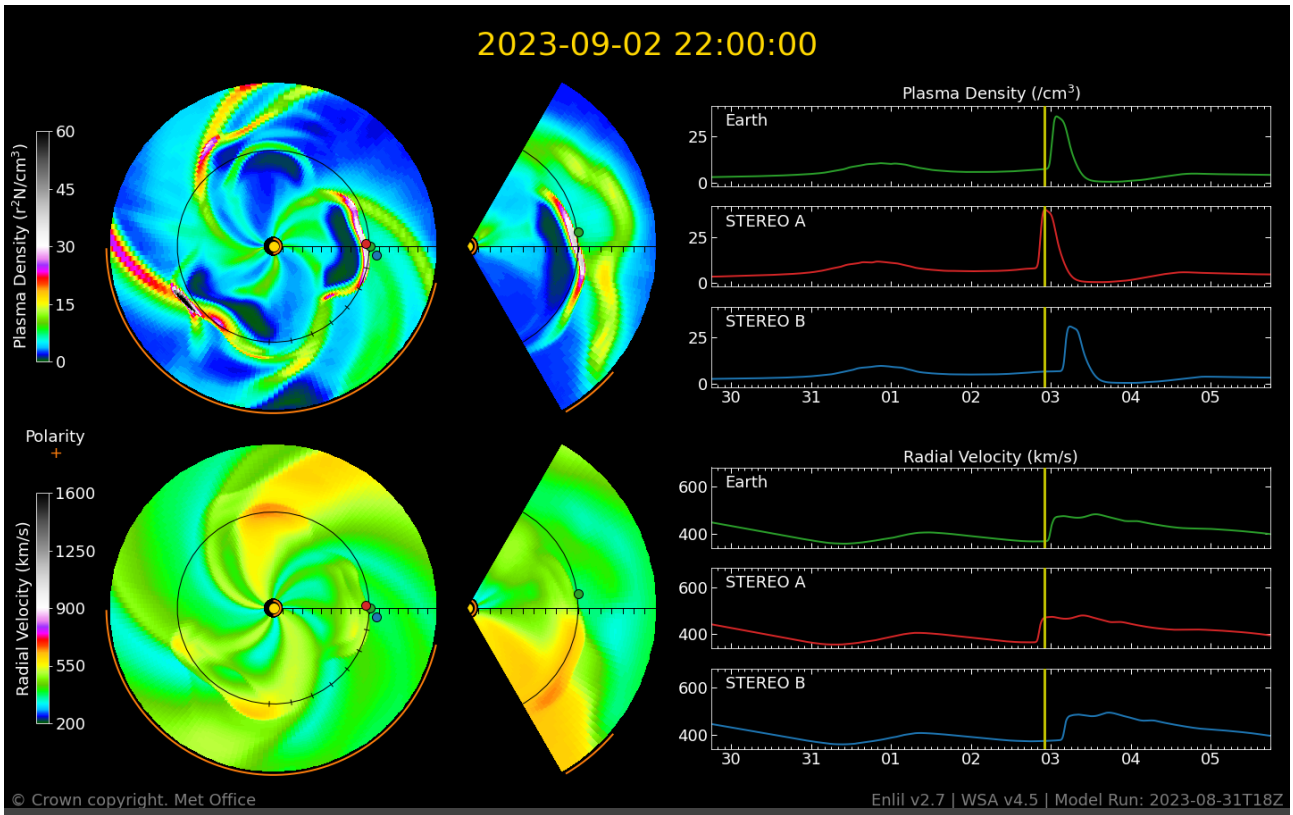

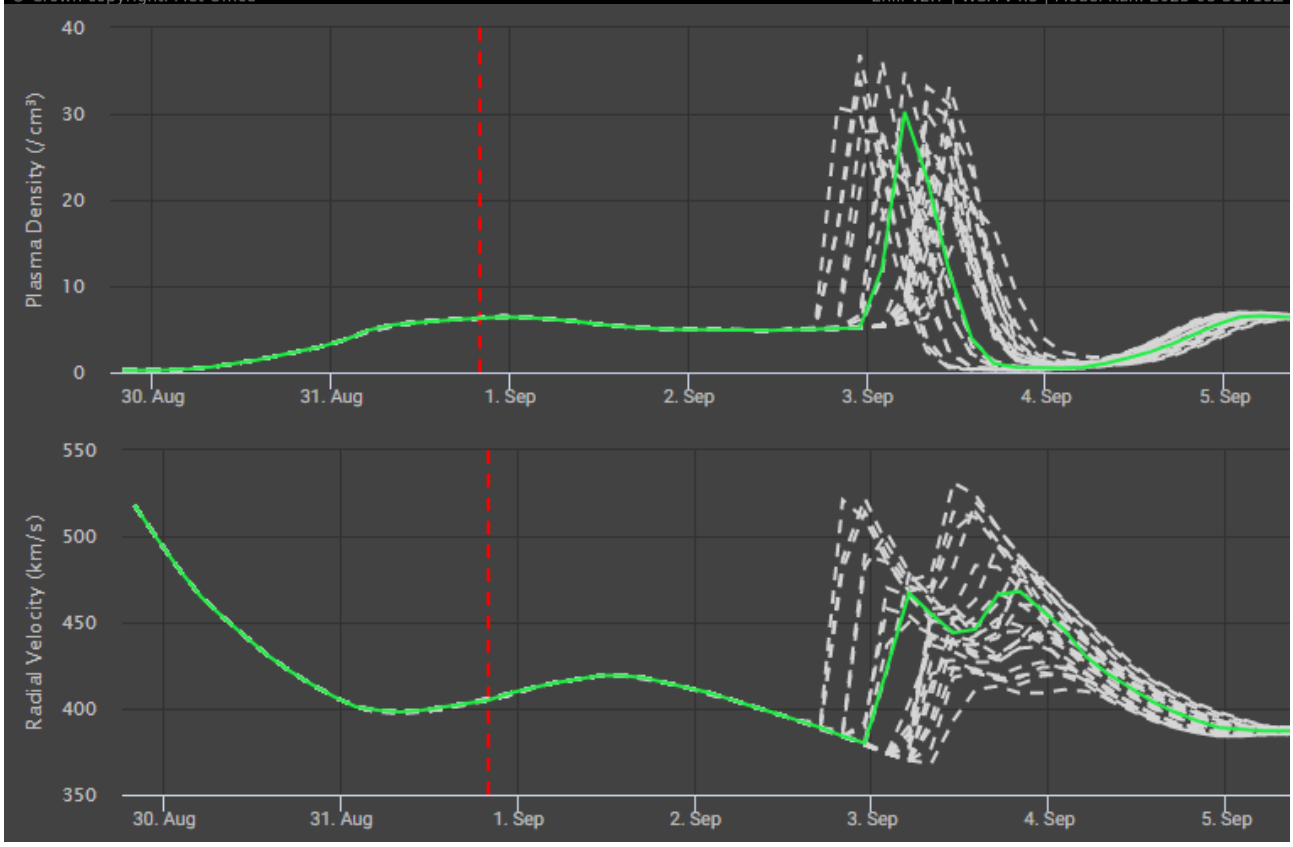

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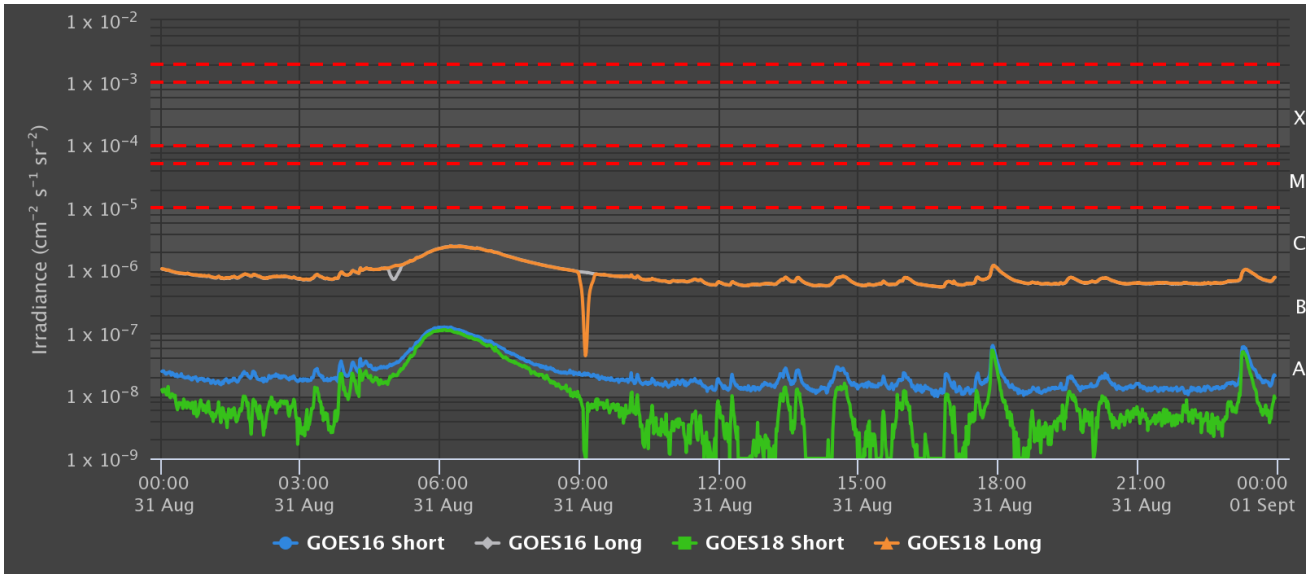
Radio Blackouts - X-Ray Flares:
Low activity is forecast, with a chance of rising to Moderate due to any M-flares, primarily from AR3413 but perhaps also AR3417.

There are six sunspot regions on the visible disc. AR3413 is the largest and most developmental, with a number of small spots around a main symmetric and dominate leader spot, although recent growth has largely stalled. AR3415 remains stable, as a small bipolar region. AR3417 has some small complexity, with two separate potential negative leader spots, but with a clear connection between them, and subsequently assessed as a single region. AR3416 and AR3418 are both small, stable and mature unipolar spots. A new and unnumbered spot has emerged in the southwest, although this is a small and simple Axx/Alpha.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES-16/18 X-ray Flux



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Solar Radiation Storms - (High Energy Protons):
High energy (greater than 10MeV) proton flux observed by GOES16 is expected to remain at background levels with just a slight chance of enhancement. The main risk of any increased proton flux would be from the occurrence of any larger flares from AR3415 or AR3413.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):
High energy (greater than 2 MeV) electron flux observed by GOES16 is expected to remain at background to moderate levels until day 2 (02 Sep). The enhancement from coronal hole (CH40/+) may then result in some electron flux response, however due to the northern latitude of the coronal hole confidence is low on the strength of any connection and the subsequent flux increase. However, Moderate flux, perhaps briefly High, is possible. Furthermore, then arrival of a CME is now anticipated later day 2 or early day 3 (late 02 Sep or early 03 Sep), this will likely drop out flux to background levels, before recovering again later day 4 (04 Sep).

The associated 24 hour fluence is expected to remain below the Active (1e8 integrated pfu) level throughout the period, with any slight rise likely to be modest and short-lived due to any CME arrival late on day 2 or early day 3 (02-03 Sep). This is supported by the Met Office REFM output.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	5	5
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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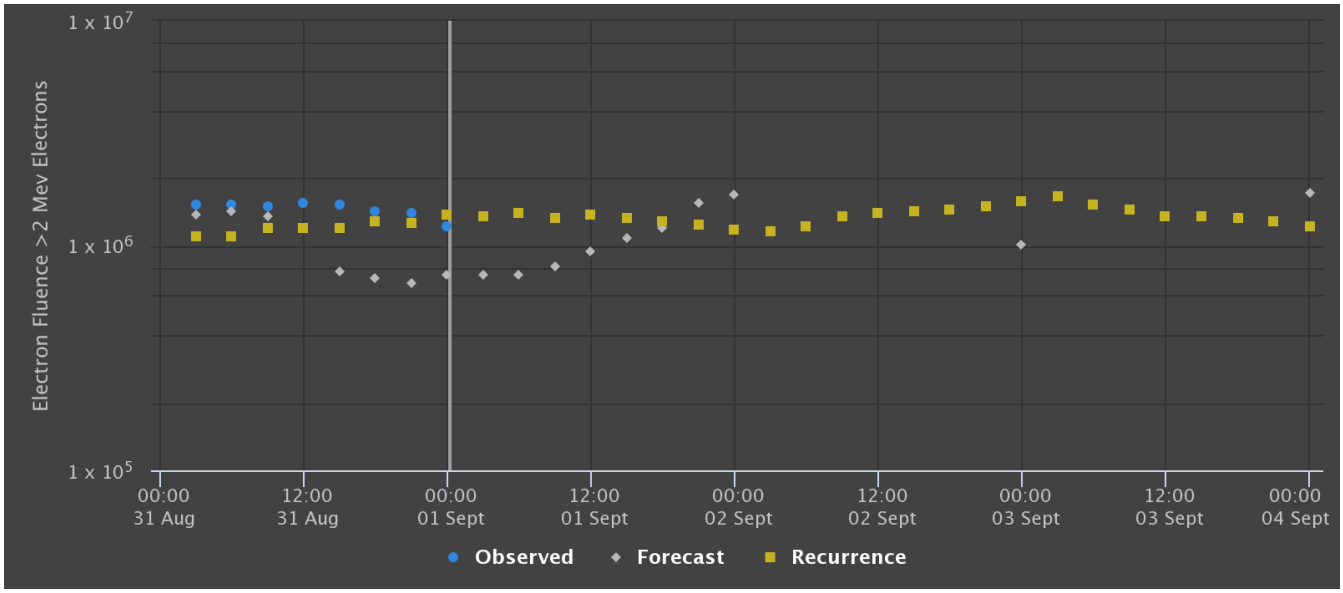
Figure 5: MOSWOC REFM electron fluence, observations and recurrence.



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